



Eurasian Watermilfoil Observation in Comfort Lake on July 21, 2014

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## **Curlyleaf Pondweed Delineation and Assessment and a Point-Intercept Plant Survey For Comfort Lake, Chisago County, 2014**

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Delineation: May 20, 2014  
Assessment: June 16, 2014  
Summer Point-Intercept Survey: July 21, 2014

Prepared for:  
**Comfort Lake/Forest  
Lake Watershed District  
Forest Lake, Minnesota**



Prepared by:  
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**January 21, 2015**

# Curlyleaf Pondweed Delineation and Assessment And a Point-Intercept Plant Survey for Comfort Lake, Chisago County, 2014

## Summary

**Curlyleaf Pondweed Delineation and Assessment Surveys:** Curlyleaf pondweed delineation for distribution and abundance was conducted on May 20, 2014. A follow-up curlyleaf assessment was conducted on June 16, 2014, 2014.

In the delineation survey, curlyleaf was not found in Comfort Lake (Figure S1) but a few native plants were sampled. No curlyleaf pondweed treatment occurred in 2014.

About a month later, in the June curlyleaf assessment, curlyleaf had sprouted and was found at 7-sites but growth was mostly light (Figure S1).

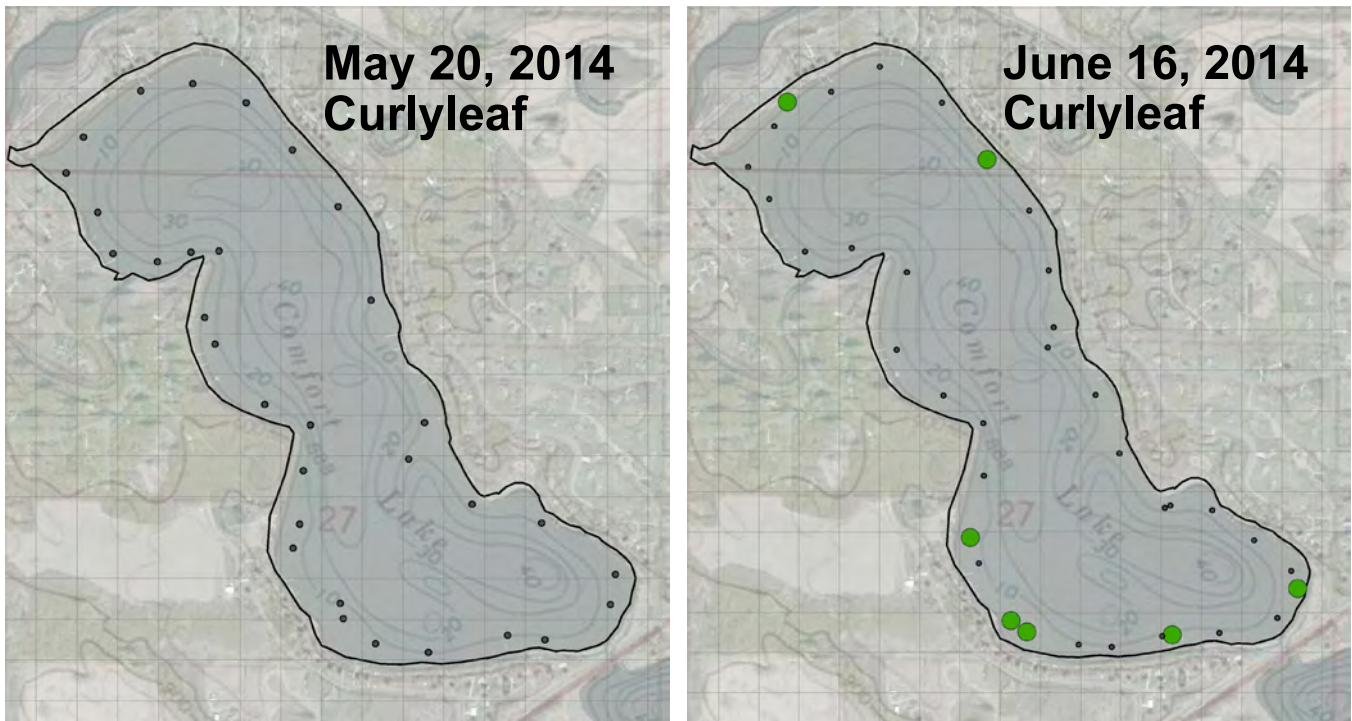


Figure S1. [left] **DELINEATION:** Map of curlyleaf pondweed distribution from the May 20, 2014 survey. Black dots = sample locations. No curlyleaf pondweed was observed on May 20, 2014. **TREATMENT:** No curlyleaf pondweed treatment occurred in 2014. [right] **ASSESSMENT:** Map of curlyleaf pondweed assessment sites for June 16, 2014. Black dots = no curlyleaf and green circles = light growth.

## Summer Aquatic Plant Point-Intercept Survey

On July 21, 2014 a full point-intercept aquatic plant survey was conducted on Comfort Lake. A total of 180 sites were monitored. Comfort Lake has a fair diversity of aquatic plants, with 9 submerged species (including curlyleaf pondweed and Eurasian watermilfoil) and 3 floatingleaf species including 2 water lily species. A summary of plant occurrence and relative densities is listed in Table S1. The most common submerged aquatic plants in the lake are sago pondweed and coontail.

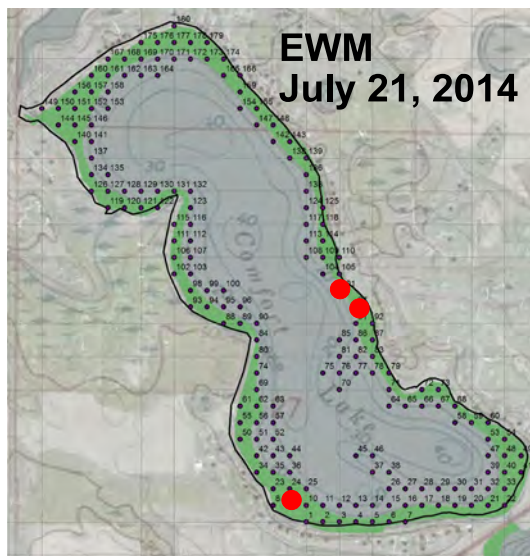
**Table S1. Comfort Lake aquatic plant occurrences and densities for the July 21, 2014 survey. Density ratings are 1-5 with 1 being low and 5 being most dense. Plants grew to a depth of 6 feet.**

	All Stations (n=180)		
	Occur	% Occur	Density
Duckweed ( <i>Lemna sp</i> )	1	1	1.0
Spatterdock ( <i>Nuphar variegatum</i> )	36	20	3.1
White waterlily ( <i>Nymphaea sp</i> )	23	13	1.5
Coontail ( <i>Ceratophyllum demersum</i> )	23	13	2.2
Elodea ( <i>Elodea canadensis</i> )	2	1	1.5
Northern watermilfoil ( <i>Myriophyllum sibiricum</i> )	12	7	1.2
Eurasian watermilfoil ( <i>M. spicatum</i> )	3	1	3.0
Cabbage ( <i>Potamogeton amplifolius</i> )	17	9	1.9
Curlyleaf pondweed ( <i>P. crispus</i> )	9	5	1.0
Stringy pondweed ( <i>P. sp</i> )	11	6	1.0
Flatstem pondweed ( <i>P. zosteriformis</i> )	4	2	1.0
Sago pondweed ( <i>Stuckenia pectinata</i> )	24	13	1.4



**Figure S2. Coontail at a density of a “3” on a sample rake.**

**Discovery of Eurasian Watermilfoil:** During the point-intercept survey on July 21, 2014, Eurasian watermilfoil (EWM) was identified at three sites (Figure S3). EWM was verified by the MnDNR on August 6, 2014 at 13 sites. Due to the lateness of the season, only the EWM area at the public access was treated. EWM will be monitored in the next few years to characterize distribution and abundance.



**Figure S3. EWM locations (red dots) on the July 21, 2014 point-intercept survey.**

# Curlyleaf Pondweed Delineation and Assessment and A Point-Intercept Plant Survey for Comfort Lake, Chisago County, 2014

## Introduction and Methods

Comfort Lake has an area of 218 acres with a littoral area of 90 acres (MnDNR). The maximum depth of Comfort Lake is 37 feet. The extent of heavy growth of curlyleaf pondweed is unknown. The objectives of the curlyleaf surveys were to delineate the acreage of curlyleaf pondweed to treat and then treat is necessary and then after treatment, assess the effectiveness of the treatment.

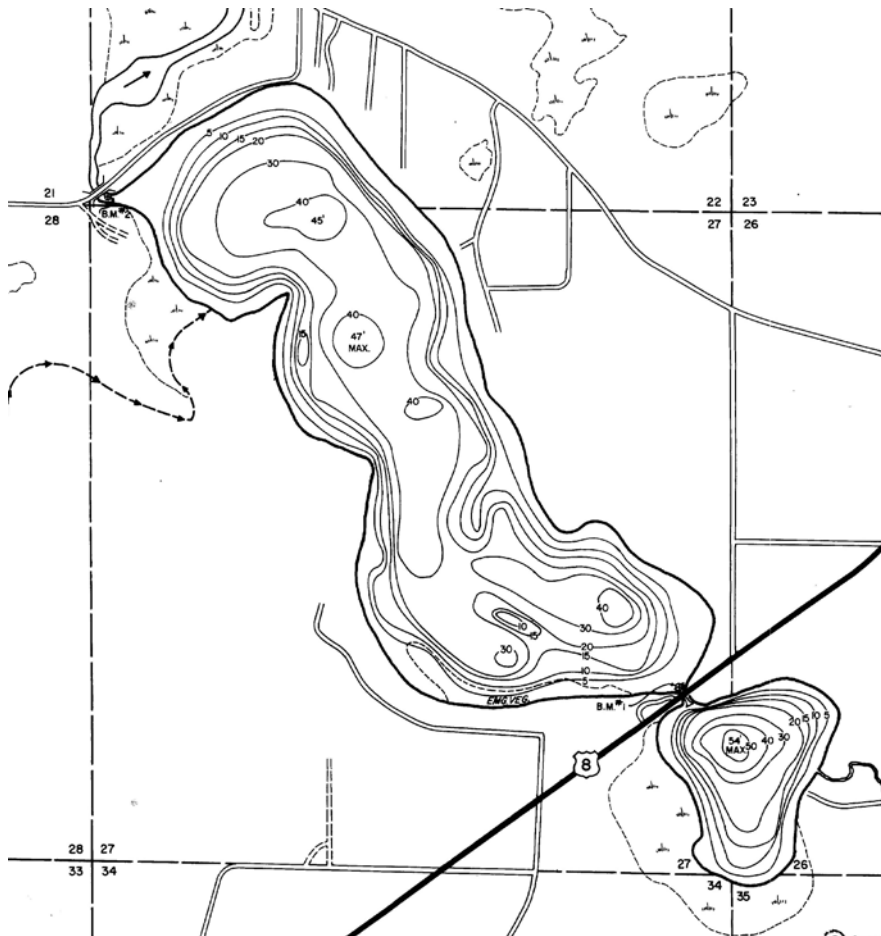


Figure 1. Contour map of Comfort Lake (source: MnDNR).

**Delineation and Assessment Methods:** An initial curlyleaf pondweed delineation was conducted on May 20, 2014. The entire perimeter of the lake was checked for curlyleaf pondweed. A total of 32 sites were sampled for aquatic plants. A follow-up curlyleaf pondweed assessment was conducted on June 16, 2014 to characterize the status of curlyleaf pondweed at its peak growing period. The same methodology that was used for the delineation was used for the assessment. A total of 37 sites were sampled for aquatic plants.

**Summer Point-Intercept Survey Methods:** A point intercept aquatic plant survey of Comfort Lake was conducted by Blue Water Science on July 21, 2014, and 180 points were sampled out to 15 feet of water depth (Figure 2). The deepest depth of plant colonization in Comfort Lake was out to 6 feet, although all sites were sampled. Sample points were placed 50 meters apart on a grid that covered the lake. Each sample point was equal to 0.62 acres. At each sample point, a sampling rake was lowered into the water and a plant sample was taken. The plant species were recorded and the density of each species was assigned. Densities were based on the coverage on the teeth of the rake. Density ratings were from 1 to 5 with 1 being sparse and 5 being a matted nuisance. Based on these sample sites, plant distribution maps were constructed. A chart showing examples of curlyleaf growth conditions are shown on the next page.



**Figure 2. Sample location map for the aquatic plant surveys conducted on Comfort Lake. Green shading represents the littoral zone of Comfort Lake.**

Curlyleaf pondweed densities are represented on a scale of 1 to 5 with 5 being densest.

### Light Growth Conditions

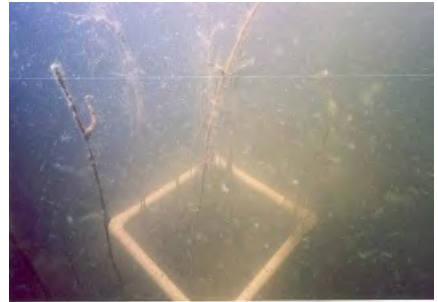
Plants rarely reach the surface.

Navigation and recreational activities are not generally hindered.

Stem density: 0 - 160 stems/m<sup>2</sup>

Biomass: 0 - 50 g-dry wt/m<sup>2</sup>

Estimated TP loading: <1.7 lbs/ac



*MnDNR rake sample density equivalent for light growth conditions: 1, 2, or 3.*

### Moderate Growth Conditions

Broken surface canopy conditions.

Navigation and recreational activities may be hindered.

Lake users may opt for control.

Stem density: 100 - 280 stems/m<sup>2</sup>

Biomass: 50 - 85 g-dry wt/m<sup>2</sup>

Estimated TP loading: 2.2 - 3.8 lbs/ac



*MnDNR rake sample density equivalent for moderate growth conditions: 2, 3 or sometimes, 4.*

### Heavy Growth Conditions

Solid or near solid surface canopy conditions.

Navigation and recreational activities are severely limited.

Control is necessary for navigation and/or recreation.

Stem density: 400+ stems/m<sup>2</sup>

Biomass: >300 g-dry wt/m<sup>2</sup>

Estimated TP loading: >6.7 lbs/ac



*MnDNR rake sample density has a scale from 1 to 4. For certain growth conditions where plants top out at the surface, the scale has been extended: 4.5 is equivalent to a near solid surface canopy and a 5 is equivalent to a solid surface canopy. Heavy growth conditions have rake densities of a 4 (early to mid-season with the potential to reach the surface), 4.5, or 5.*

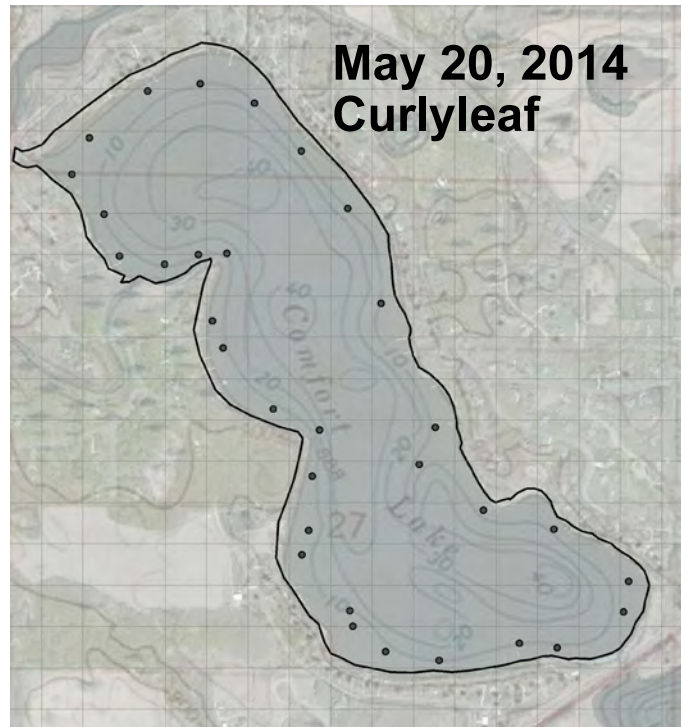
## Results of the Curlyleaf Pondweed Delineation on May 20, 2014

A curlyleaf delineation was conducted using rake sampling on May 20, 2014. Thirty-two sites were examined. At this time of the year curlyleaf was not found in Comfort Lake (Table 1 and Figure 3).

### Curlyleaf Conditions in Comfort Lake, May 20, 2014

**Table 1. Aquatic plant occurrences and densities based on rake sampling for May 20, 2014. Densities are based on a scale of 1 to 5 with '1' being light and '5' representing heavy growth.**

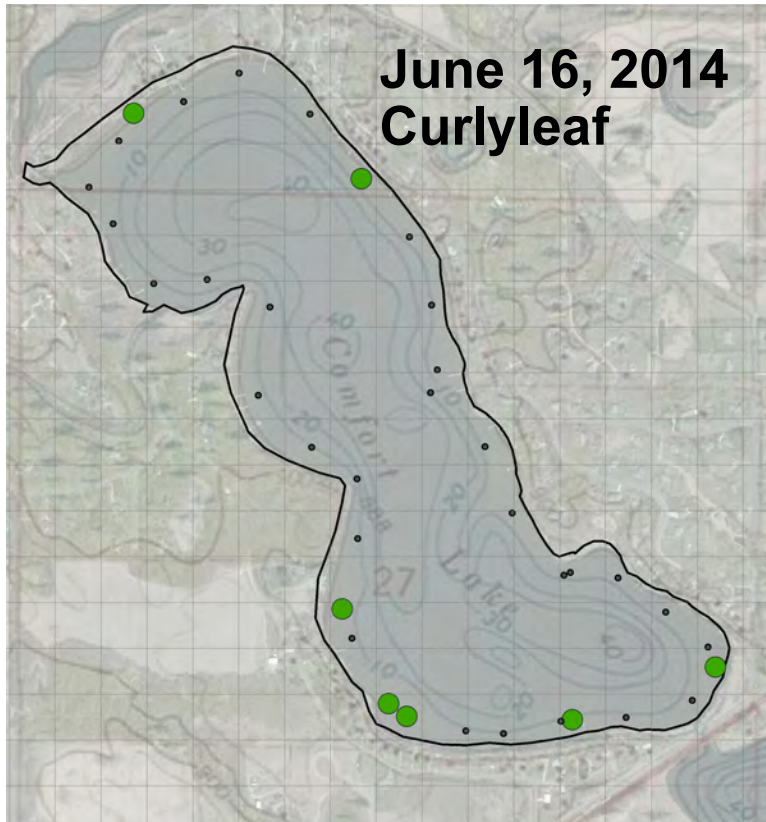
Site	Depth (ft)	Water lilies Root	Coontail
1	5		
2	7		
3	9		
4	6		
5	7		
6	6		
7	6		
8	7		
9	11		
10	11		
11	7		
12	6		
13	4		3
14	5		
15	5		
16	5	1	
17	5		
18	10		
19	4		1
20	5		
21	13		
22	25		
23	4		
24	10		
25	4	1	
26	13		
27	8		
28	7		
29	5		
30	6		
31	5		
32	4	1	



**Figure 3. Map of curlyleaf delineation in Comfort Lake on May 20, 2014. No curlyleaf was observed.**

## Results of the Curlyleaf Pondweed Assessment on June 16, 2014

A total of 37 sites were assessed with rake sampling on June 16, 2014. Curlyleaf was found at 7 sample sites out of the 37 that were monitored (Table 2). Curlyleaf growth was found to be light at all 7 sites (Figure 4 and Table 2).



**Figure 4. Map of curlyleaf distribution in Comfort Lake on June 16, 2014. Green circles = light growth and black dots = sample locations.**



**Figure 5. Curlyleaf pondweed was found around Comfort Lake on June 16, 2014. [left] View of Comfort Lake, no plants were reaching the lake surface. [right] Curlyleaf was sampled at a density of a "1".**



**Table 2. Aquatic plant stem densities based on rake sampling for June 16, 2014. Densities are based on a scale from 1 to 5 with 5 being the densest.**

Site	Depth (ft)	Spatter-dock	White lilies	Cabbage	Coon-tail	CLP - stems	Elodea	EWM	NWM	Stringy pond-weed	No Plants
1	5				1	1	1				
2	6			1			1				
3	5			1						1	
4	4		1								
5	4			2		1			1		
6	5										1
7	5			2					1		
8	5										1
9	9										1
10	4										1
11	4										1
12	13										1
13	6										1
14	6										1
15	13										1
16	6				4						
17	6				2	1					
18	6										1
19	4										1
20	5					7					
21	5			1							
22	5										1
23	5										1
24	4				1	1					
25	5		3		1	3		1			
26	11										1
27	5	1				1					
28	12										1
29	13										1
30	5	1									
31	12										1
32	12										1
33	14										1
34	13										1
35	12										1
36	5		3								
37	4	1									
<b>Average</b>		<b>1.0</b>	<b>2.3</b>	<b>1.4</b>	<b>1.8</b>	<b>2.1</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	
<b>occurrence (37 sites)</b>		3	3	5	5	7	2	1	2	1	21
<b>% occurrence</b>		8	8	14	14	19	5	3	5	3	

## Summer Aquatic Plant Point-Intercept Survey

On July 21, 2014 a full point-intercept aquatic plant survey was conducted on Comfort Lake. A total of 180 sites were monitored.

Comfort Lake has a fair diversity of aquatic plants, with 9 submerged species (including curlyleaf pondweed and Eurasian watermilfoil) and 3 floatingleaf species including 2 water lily species. A summary of plant occurrence and relative densities is listed in Table 3. The most common submerged aquatic plants in the lake are sago pondweed and coontail.

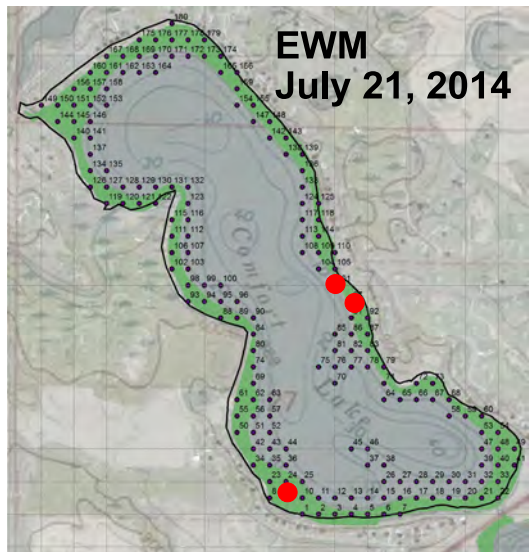
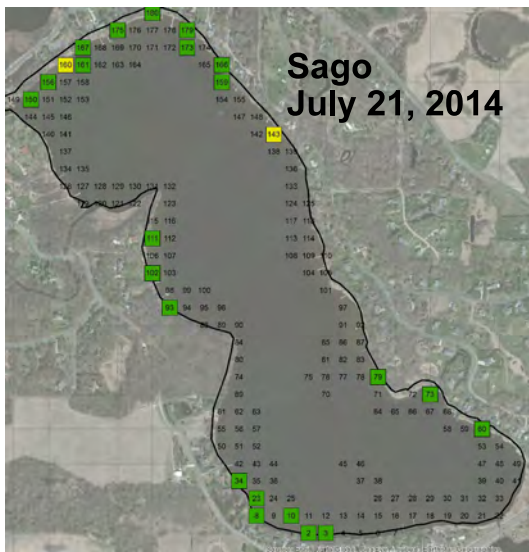
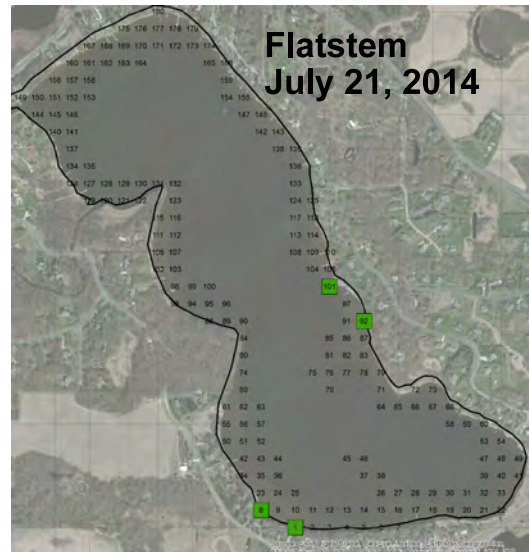
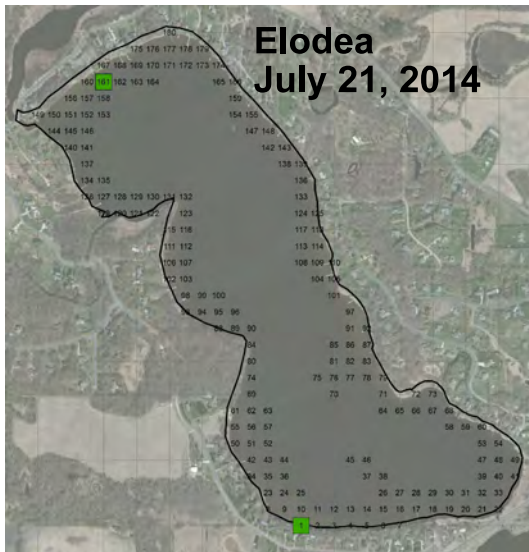
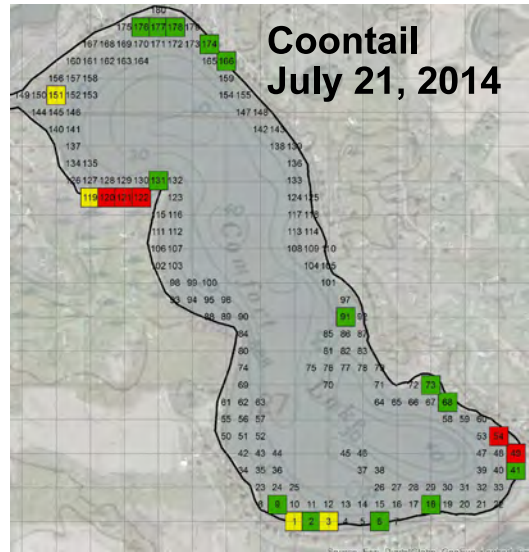
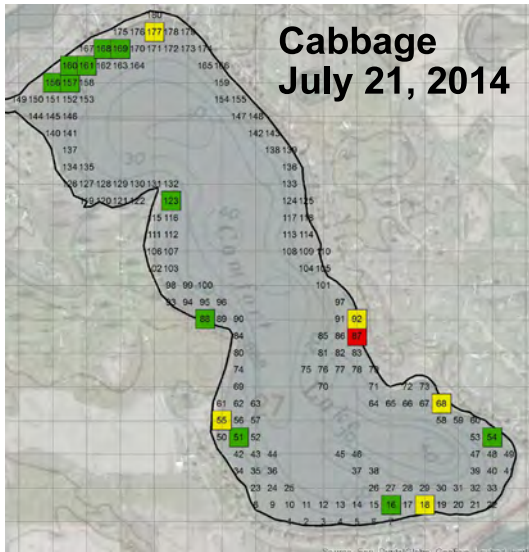
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Flatstem pondweed ( <i>P. zosteriformis</i> )	4	2	1.0
Sago pondweed ( <i>Stuckenia pectinata</i> )	24	13	1.4



**Figure 6. Coontail at a density of a “3” on a sample rake.**

# Aquatic Plant Maps of Comfort Lake from the July 21, 2014 Plant Survey



Plant diversity was above average in Comfort Lake with a total of 9 submerged aquatic plant species (Table 4). Sago was the most common plant followed by coontail.

**Table 4. Aquatic plant occurrence and density for individual sample points in Comfort Lake, July 21, 2014.**

Site	Depth (ft)	Duckweed	Spatterdock	White lilies	Cabbage	Coontail	CLP	Elodea	EWM	Flatstem	NWM	Sago	Stringy	No plants
1	3			2		3		2		1	1			
2	2		3	1		2						2		
3	3					3	1					1		
4	3		3	1										
5	4		2											
6	4		3	2		1								
7	2			2										1
8	3			3						1		1		
9	3			1		2			1		2			
10	4		5								1	1		
11	11													1
12	TD													1
13	TD													1
14	14													1
15	7													
16	4		3		1									
17	4													1
18	5				3	1								
19	4		4											
20	6		1											
21	6		2											
22	2		2	2										
23	3						1				1	1		
24	4		4											
25	12													1
26	TD													1
27	TD													1
28	TD													1
29	TD													1
30	TD													1
31	TD													1
32	12													1
33	4		1											
34	4		4									1		
35	6													1
36	TD													1
37	TD													1
38	TD													1
39	TD													1
40	7													1
41	5		5	1		1								
42	11													1
43	TD													1
44	TD													1
45	TD													1
46	TD													1
47	TD													1
48	8													1
49	4					4								
50	3						1						1	
51	5				1									
52	TD													1
53	17													1
54	4				1	4								
55	3				3								1	
56	5		2											
57	TD													1

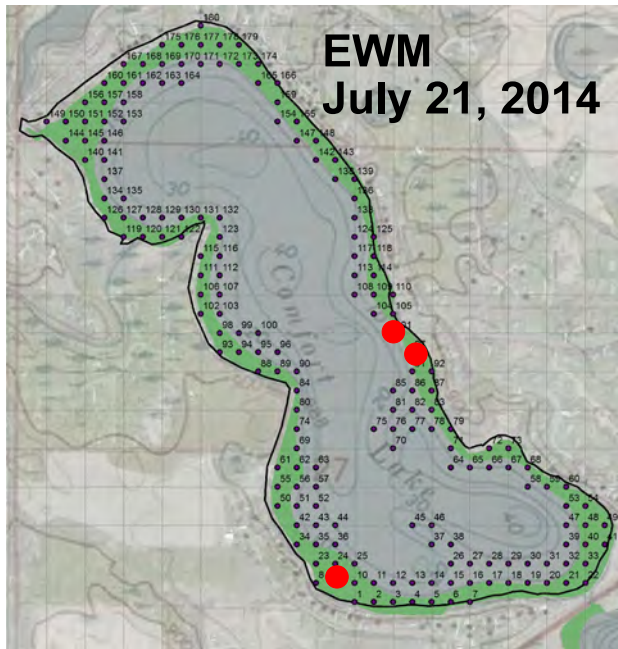
**Table 4. Aquatic plant occurrence and density for individual sample points in Comfort Lake, July 21, 2014.**

Site	Depth (ft)	Duckweed	Spatterdock	White lilies	Cabbage	Coontail	CLP	Eloдея	EWM	Flatstem	NWM	Sago	Stringy	No plants
58	TD													1
59	12													1
60	3						1					1		
61	3			3										
62	7													1
63	TD													1
64	TD													1
65	13													1
66	13													1
67	13													1
68	3				3	1	1							
69	14													1
70	TD													1
71	4													1
72	3		5											
73	4					2					1	2	1	
74	12													1
75	TD													1
76	11													1
77	TD													1
78	5		2										1	
79	1											1	1	
80	5		3											
81	6													1
82	5													1
83	4		4											
84	3													1
85	TD													1
86	4		5											
87	3				4								1	
88	3				2						1			
89	4		4											
90	TD													1
91	5		4			1								
92	3				3					1				
93	2											2		
94	6		2											
95	9													1
96	TD													1
97	3								1		1			
98	4		4											
99	TD													1
100	TD													1
101	5		2						5	1				
102	3			1							1	1		
103	12													1
104	5													1
105	2												1	
106	4			1							1			
107	TD													1
108	6													1
109	3													1
110	1													1
111	3			1							2	1		
112	TD													1
113	TD													1
114	3													1
115	2													1
116	8													1
117	TD													1
118	2													1
119	2			1		3								
120	3	1				4								

**Table 4. Aquatic plant occurrence and density for individual sample points in Comfort Lake, July 21, 2014.**

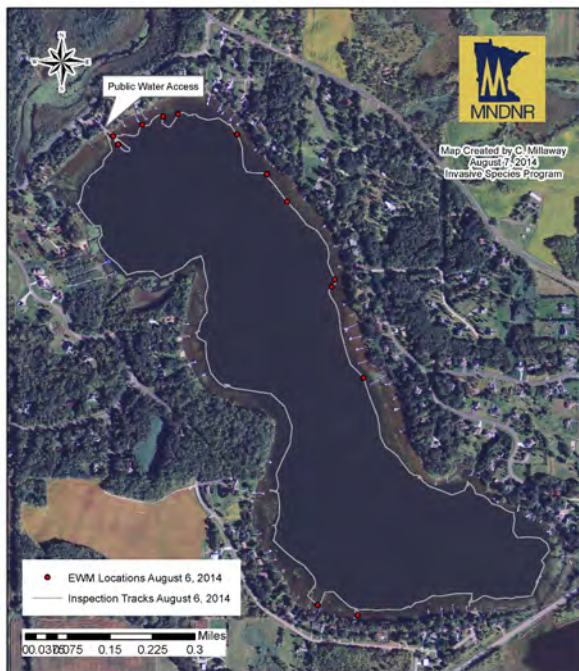
Site	Depth (ft)	Duckweed	Spatterdock	White lilies	Cabbage	Coontail	CLP	Elodea	EWM	Flatstem	NWM	Sago	Stringy	No plants
121	5			1		5								
122	4		2	1		4								
123	4				2								1	
124	TD													1
125	2													1
126	2		1	2										
127	11													1
128	TD													1
129	TD													1
130	10													1
131	6					1								
132	14													
133	7													1
134	5		3											
135	TD													1
136	5		4											
137	9													1
138	TD													1
139	3													1
140	8													1
141	TD													1
142	5													1
143	3		2	1							1	3		
144	4		4											
145	10													1
146	TD													
147	TD													1
148	5		4				1							
149	2			2										
150	3			2			1					1		
151	4		3			3								
152	TD													1
153	TD													1
154	12													1
155	4		4											
156	3			1	1							2		
157	5				1									
158	TD													1
159	4											1		
160	3				1							3		
161	5				1		1	1			1	1		
162	TD													1
163	TD													1
164	TD													1
165	5												1	
166	2			1		2						2		
167	2			1								1	1	
168	4				2									
169	6				1									
170	6													1
171	TD													1
172	10													1
173	4											1		
174	3		3			1								
175	2											1		
176	3		3			1								
177	5				3	1							1	
178	4					1								
179	3						1					2		
180	1.5											1		
Average occurrence (180 sites)		1.0	3.1	1.5	1.9	2.2	1.0	1.5	3.0	1.0	1.2	1.4	1.0	93
% occurrence		1	20	13	9	13	5	1	1	2	7	13	6	

# Eurasian Watermilfoil Discovered in Comfort Lake in 2014



During the point-intercept survey on July 21, 2014, Eurasian watermilfoil (EWM) was identified at three sites (Figure 7a). EWM was verified by the MnDNR on August 6, 2014 at 13 sites (Figure 7b). Due to the lateness of the season, only the EWM area at the public access was treated (Figure 7c). EWM will be monitored in the next few years to characterize distribution and abundance.

Figure 7a. EWM locations (red dots) on the July 21, 2014 point-intercept survey.



Comfort Lake, Chisago County (13005300)  
Eurasian watermilfoil Inspection: August 6, 2014  
Invasive Species Program



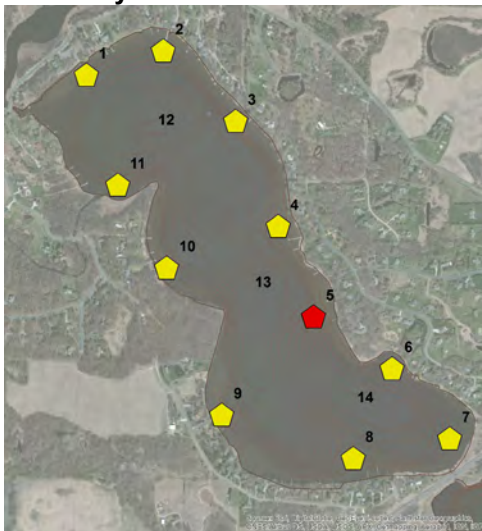
Figure 7c. EWM treatment area in front of the public access.

## Potential for Curlyleaf Pondweed and Eurasian Watermilfoil Growth Based on Lake Sediment Characteristics

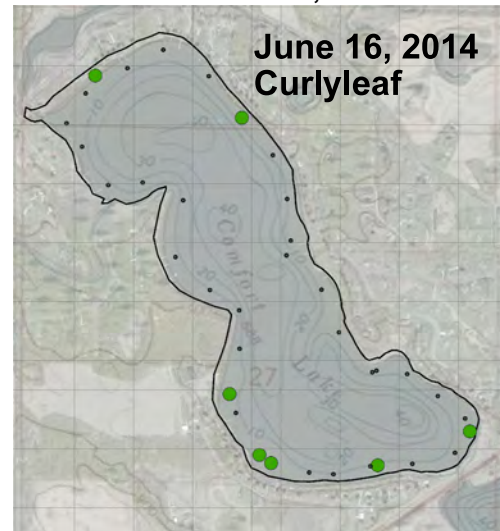
Lake sediment sampling has been used to predict lake bottom areas that have the potential to support heavy curlyleaf pondweed plant growth. Based on the key sediment parameters of pH, sediment bulk density, organic matter, and the Fe:Mn ratio (McComas, unpublished), the predicted growth characteristics of curlyleaf pondweed in Comfort Lake are shown in Figure 8.

Lake sediment sampling also has been used to predict lake areas that have the potential to support various types of EWM growth. Based on the key sediment parameters of  $\text{NH}_4$  and organic matter (McComas, unpublished), a map was prepared that predict the type of growth that could be expected in the future in Comfort Lake (Figure 8).

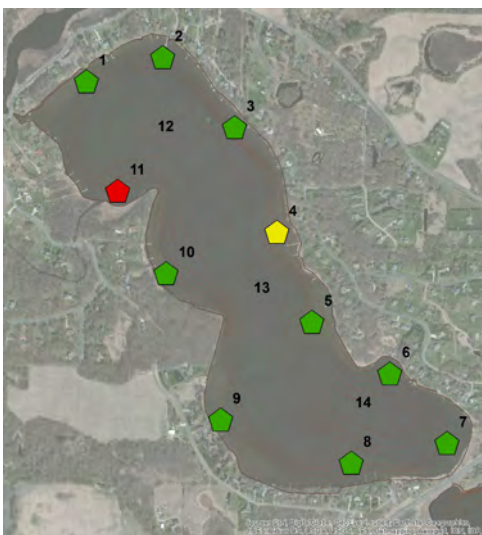
**Predicted Curlyleaf Growth**



**Actual CLP Growth - June 16, 2014**



**Predicted Eurasian watermilfoil Growth**



**Actual EWM Growth - August 6, 2014**



**Figure 8. [top] Curlyleaf pondweed predicted (left) and actual (right) growth maps. [bottom] Eurasian watermilfoil predicted (left) and actual (right) growth maps.**



# APPENDIX

## COMFORT LAKE 2012 WATER QUALITY MONITORING REPORT

### Comfort Lake

**2012 Lake Grade: C**

- DNR ID #: 130053
- Municipality: City of Wyoming
- Location: Section 27 T33N-R21W
- Lake Size: 218 Acres
- Maximum Depth: 47 ft
- Ordinary High Water Mark: 887.2 ft
- 41% Littoral

Note: Littoral area is the portion of the lake <15 ft and dominated by aquatic vegetation.

### Big Comfort Lake

City of Wyoming, Chisago Co.

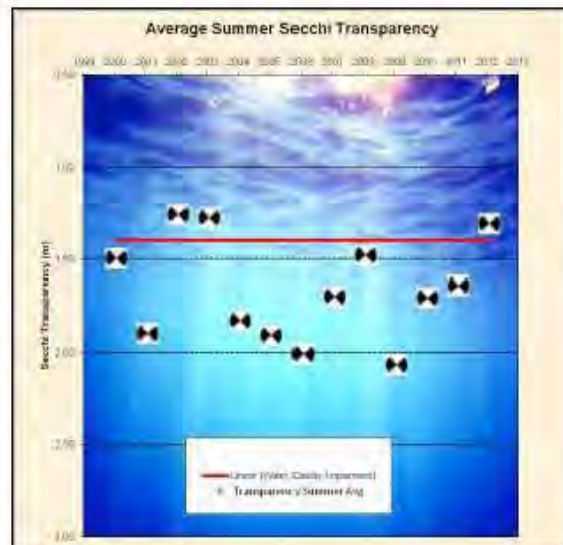
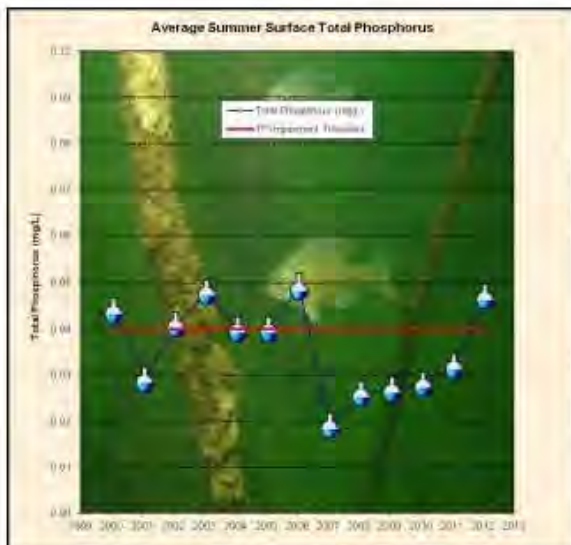
Lake ID: 130063

■ Sampling site  
Contours in meters

### Summary Points

- Comfort Lake was considered a mesotrophic lake in 2012, based on the Carlson Trophic State Index.
- **Comfort Lake is listed on the MPCA's Impaired Waters List for excessive nutrients.**
- **Curly leaf pondweed (an invasive aquatic plant) is extensive in this lake.**
- **Comfort Lake has exhibited a declining trend in water quality starting in 2010 which appears to be correlated with an increase in growing season precipitation and watershed runoff.**
- The major land use is a mix of semi-urban, rural, and agricultural.
- The lake does stratify throughout the summer months.

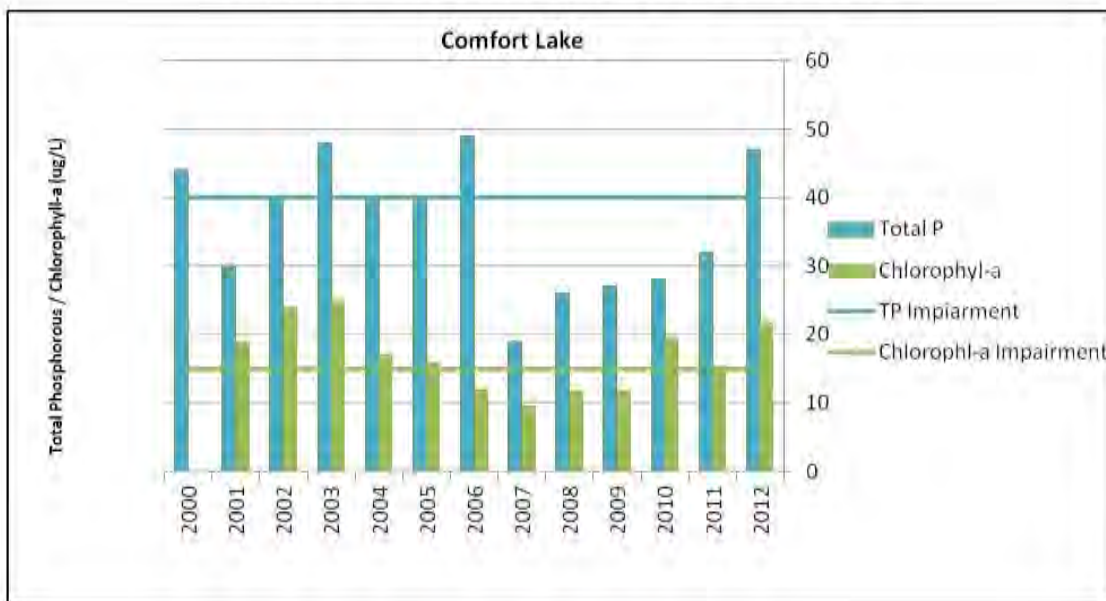
### 2012 Summer Average for Phosphorus & Transparency



### 2012 Water Quality Sample Readings

Date	Total Phosphorus (mg/L)	Chlorophyll-a (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)
4/29/2012 14:00	0.041	13	1.3	2
5/4/2012 10:36				2.05
5/5/2012 10:36	0.033	9.2	1.2	
5/23/2012 12:00	0.021	12	0.69	
5/31/2012 14:45	0.076	20	1.3	1.55
6/20/2012 10:45	0.01	21	0.25	1.15
6/27/2012 13:30	0.039	24	1.4	1.25
7/13/2012 11:20	0.059	32	2	0.95
7/26/2012 11:15	0.027	27	3.4	0.85
8/8/2012 14:45	0.012	32	1.3	1
8/26/2012 14:20	0.062	10	1.3	1.5
9/7/2012 14:30	0.017	9.8	1.1	1.55
10/3/2012 14:15	0.117	21	1.2	1.95
10/12/2012 13:45	0.036	8.2	1.4	2
10/22/2012 12:15	0.037	14	1.6	1.9
	<b>0.047</b>	<b>21.867</b>	<b>1.472</b>	<b>1.306</b>
	Water Quality Threshold Exceeded (0.04 mg/L or higher)			Water Quality Threshold Exceeded (1.4 meters or less)

### Phosphorus & Chlorophyll Trend (2000-2012)



## COMFORT LAKE SURFACE WATER ELEVATION STATISTICS

Outlet Elevation (rock weir) = 885.4

DNR Ordinary High Water (OHW) elevation = 887.2

100 Year Flood Elevation (CLFLWD) = 889.5

Highest recorded: 888.32 ft (07/02/1975)

Lowest recorded: 884.8 ft (10/08/1969)

Datum: NGVD 29 (ft)

